A PLEISTOCENE PENEPLAIN IN THE COASTAL PLAIN

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The Black Belt of Alabama is famous throughout the state, and in the surrounding states, for its great fertility, its production of cotton and corn, the levelness of its plantations, the large proportion of negroes to whites, and its numerous ante-bellum mansions—the visible manifestations of its former wealth.

As one rides over the gently undulating surface of the region, with its deep black soil, and crosses the steep-sided gullies and the bluff-bordered rivers, he is impressed with the aspect of topographic youth. However, a more careful study in the field and of the geological literature forces one to the conclusion that the region is not in the youthful stage of a first cycle of erosion, nor in a mature stage of erosion, but that the surface is a recently raised plain, so flat as almost to make the term peneplain—almost a plain—inappropriate. The following excellent description will assist one in visualizing the region:

> The surface of the country, underlaid by the Rotten Limestone, is but little diversified; it is, however, occasionally broken into rounded bald knolls, as may be seen between Arcola and Demopolis, and between Livingston and Sumterville. The summits of these hillocks are sometimes ornamented with cedars, but more frequently they are quite bare, or covered with but a scanty vegetation; even where the surface is but slightly undulating, bald spots occur where the naked rock has come up. But the most remarkable feature of this region is the extensive tracts of land covered with a deep, black soil of great depth and extraordinary fertility, which may be seen in various parts of Sumter, Greene, Marengo, Perry, and Dallas, but more particularly in the "cane brake." The surface of these remarkable tracts has barely sufficient inclination to admit of easy drainage, without giving the water force enough to remove the soil, so that, instead of excavating a channel at the bottom of the trough-like depressions where this sort of land occurs, it is absorbed by the soil, or spreads over a considerable space, where it loses all transporting power.

The unbroken surface of this region is due to the homogeneous character of the limestone, which suffers waste equally on this account, over considerable areas; and hence the entire absence of ravines, and other abrupt irregularities. . . . . In the uncleared parts of the cane brake, ... one can scarcely satisfy himself that he is not standing on the low grounds of a river; the deep, alluvial-looking soil beneath his feet, the moisture-loving long moss (Tillandsia usneoides) above his head, together with an undergrowth of Sabals, Palmettoes, and other natives of damp soils, strengthen the illusion.[1]

Professor Eugene A. Smith's accurate and suggestive description is as follows:

The Selma chalk underlies a belt entering the State from Mississippi and extending eastward with an average width of 20 to 25 miles, to a short distance beyond Montgomery, where its distinctive characters are lost or merged into those of the "blue-marl region." . . . . The somewhat uniform composition of the Selma chalk has caused it to be more deeply and evenly wasted by erosion and solution than the more sandy formations north and south of it. As a consequence, its outcrop is in the shape of a trough, with a gently undulating, almost unbroken surface except where remnants of the once continuous Lafayette mantle have protected the underlying limestone from erosion and have thus formed knobs and ridges capped with its loams and pebbles.

In this belt, more than in any other of the Coastal Plain, the soils show their residuary character. They are, as a rule, highly calcareous clays and, where much mixed with organic matters, of black color. Throughout this section are areas originally destitute of trees and hence known as "prairies." From the agricultural point of view, the Selma chalk or black belt is the most highly favored part of the State and, apart from the cities, holds the densest population.[2]

R. M. Harper[3] characterizes the topography as "gently undulating in a manner difficult to describe, though probably due almost wholly to normal erosion processes," and points out that "some of the region, mostly remote from the rivers, is so level that the railroads have built straight tangents (i.e., straight tracks) a dozen or more miles in length." He also points out the rarity of swamps. The region is traversed by rivers that are, in most places, bordered by steep, bare bluffs—in some places 60 feet

[1] *Tuomey's Second Biennial Report*, pp. 134–37, 1848, quoted by Eugene A. Smith in his report on the *Geology of the Coastal Plain of Alabama* (1894), pp. 282–84.

[2] *Underground Water Resources of Alabama* (1907), p. 13.

[3] Roland M. Harper, "Economic Botany of Alabama," *Geographical Report on Forests*, Monograph 8, Part 1, 1913.

high—of chalky limestone, and the tributary streams have all the characteristics of youth.

The sides of the Black Belt trough are bounded on the north and south by ridges, formed of the more resistant strata of the Coastal Plain, which rise 200 to 300 feet above the general level of the surface. The pronounced cuesta which forms the southern border of the trough is composed of the sandy, more resistant Ripley (Cretaceous) sediments.

The Black Belt, Black Prairie, Cotton Belt, or Cane Brake, as it has been variously called, can be briefly described as a belt of rich, black soil with an average width of 20 to 25 miles, and an area in Alabama of about 4,300 square miles. It extends in an east-west direction in south central Alabama and conforms exactly with an easily decomposed, impure, chalky limestone of rather uniform composition (Selma chalk) which has a thickness of about 1,000 feet in the western part of the state and thins out and disappears in the east near Montgomery. This formation dips to the south at the rate of 30 to 40 feet to the mile while the surface slopes at a much less rapid rate in the same direction. It is the weathering of the beveled edges of this limestone that determines the width and position of the Black Belt. The soil formed from this rock is a clay of exceptional fertility but somewhat difficult to cultivate because it bakes in summer and becomes tenacious mud in winter.

After the deposition of the Coastal Plain sediments a deposit of red sandy loam, called the Lafayette formation, was laid down on them, either during the early Pleistocene or near the close of the Pliocene, and formed a veritable mantle covering many hundreds of square miles. The depth of this formation is, in places, as much as fifty feet, but little of it has a thickness of more than 25 feet. The origin of the Lafayette has given rise to much discussion,[1] but as the underlying formations in Alabama contain little quartz from which pebbles could be made, the abundant water-worn quartz pebbles show that in this state, at least, it must have been transported long distances. On the sides of the Black Belt trough some knobs and ridges are capped by this deposit, proving

[1] W. W. Shaw, *U.S. Prof. Paper 108 H.*

that the Black Belt was once covered with it. The almost complete absence of the Lafayette over the area underlain by the Selma chalk and its presence on other parts of the Coastal Plain north and south is attributable to the greater ease with which the chalk is weathered and eroded. Because of its solubility and lack of strength, the streams that flow through the limestone quickly cut their beds to grade. In other parts of the Coastal Plain which are underlain by limestone, it is also found that very little remains of the once widespread cover of Lafayette.

The features which lead to the belief that the Black Belt of Alabama is in the youthful stage of a first cycle of erosion was based upon the facts (1) that its surface is so level in certain areas as to give it an appearance of topographic youth; (2) that the rivers are bordered by steep banks or bluffs and are in a youthful stage of an erosion cycle.

The evidences which indicate that the region was peneplained and has been elevated in comparatively recent times are: (1) that it occupies a troughlike depression 200 to 300 feet lower than the bordering lands to the north and south; (2) that, although the soil is a clay, and is consequently very favorable for the retention of water, swamps are nevertheless uncommon except in river bottoms, showing that the drainage had been thoroughly established; (3) that the Lafayette, which once covered the Black Belt, has been almost entirely removed from it; (4) that the thick, residual soils of the region were probably formed chiefly after the land was reduced to a peneplain (at the present time they are being rapidly eroded away); (5) that the present youthful appearance of the region is due to a comparatively recent elevation of the peneplain 60 or more feet, which permitted the rivers to sink their beds; (6) that the peneplanation must have taken place during the Pleistocene, as is shown by the fact that the region was reduced to a nearly level surface and that a thick residual soil was formed after the removal of the Lafayette, a formation that was deposited not earlier than late Pliocene and, more probably, during the Pleistocene.

Estimates of the length of geological time are so uncertain that little dependence can be placed on them, but it is, nevertheless,

interesting to speculate upon the time required for the removal of the Lafayette loams, sands, and gravels from the Black Belt and for the reduction of the surface during part of the Pleistocene. Penck's estimate of 500,000 to 1,000,000 years for the duration of the Pleistocene, based upon the rate of advance and retreat of the Pleistocene Ice Sheets, is to be contrasted with Barrell's[1] minimum estimate of 1,500,000 years based upon a study of radioactivity. A few years ago Barrell's estimate would have seemed extravagant, but when one considers that a region, such as the one under discussion, has been denuded of a thick deposit of gravel and loam, has been reduced to a peneplain, has been weathered so long as to form a thick residual soil, has been raised, and, finally, has been so dissected by streams as to make a topography of youthful aspect, the larger estimate does not seem impossible.

In 1906, Chamberlin and Salisbury[2] presented figures as to the duration of time since the Kansan glacial epoch, giving 300,000 as a likely minimum, and 1,020,000 as a likely maximum. Had the statement covered the time since the beginning of the Pleistocene, these figures would have been considerably larger.

The physiographic history of the Coastal Plain of the Gulf of Mexico has not as yet been carefully worked out, and it is probable that a thorough study will show that this surface instead of being the youthful topography of a first cycle of erosion, is, for the most part, the incised surface of a peneplain or a plain of marine abrasion, in which are subordinate peneplains such as that of the Black Belt. The unconsolidated sediments and broad intervales give the impression of youth but the beveled edges of the formations which underlie the Coastal Plain and the level, outstanding cuesta ridges are suggestive of peneplanation. The writer hopes to be able to make a further study of the physiographic history of our Gulf Coastal Plain and with it a study of the Atlantic Coastal Plain.

[1] J. Barrell, "Measurements of Geological Time," *Geological Society of America Bulletin*, Vol. XXVIII (1917), p. 892.

[2] *Earth History*, Vol. III, p. 420.